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INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 030304pct	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/NL 03/00272	International filing date (day/month/year) 10.04.2003	Priority date (day/month/year) 13.04.2002
International Patent Classification (IPC) or both national classification and IPC G01N23/00		
Applicant PANALYTICAL B.V. et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 3 sheets.

- This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 08.11.2003	Date of completion of this report 06.08.2004
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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/NL 03/00272**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*):

Description, Pages

1-15 as originally filed

Claims, Numbers

1-12 received on 04.05.2004 with letter of 30.04.2004

Drawings, Sheets

1-5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-12
	No: Claims	
Inventive step (IS)	Yes: Claims	2,9-12
	No: Claims	1,3-8
Industrial applicability (IA)	Yes: Claims	1-12
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL03/00272

- D1: NOMA ET AL.: 'Surface-sensitive X-ray fluorescence and diffraction analysis with grazing-exit geometry' X-RAY SPECTROMETRY, vol. 28, 1999, pages 433-439
- D2: NOMA ET AL.: 'Micro X-ray diffraction analysis of thin films using grazing-exit conditions' JOURNAL OF SYNCHROTRON RADIATION, vol. 5, 1998, pages 902-904
- D4: US-A-5 684 857 (DE BOKX PIETER K) 4 November 1997 (1997-11-04)

Section V

1.1. The subject matter of claim 1 is not inventive:

D1 discloses all features of claim 1 (see chapter "GRAZING EXIT X-RAY DIFFRACTION) except the following novel features:

- 1) the thin layer of the sample is "substantially single crystal"
- 2) the collimator is a slit between the X-ray source and the sample stage

re 1)

The expression "substantially" renders this feature unclear (ISPE Guidelines C-5.38), such that even novelty of this feature is doubtful. It is in any event obvious for the skilled person to try to adapt the grazing exit geometry, which is disclosed in D1 for polycrystalline thin films, also for monocrystalline thin films by conventional measures like rotating the sample, increasing the wavelength range or divergence of the incident beam etc..

re 2)

The skilled person chooses the collimator (for example two slits as in D4 or a single slit with an appropriate source) according to circumstances without the exercise of inventive skill.

Since both features are independent from each other and since both features are obvious, the subject matter of claim 1 is obvious as a whole.

1.2. The subject matter of independent use claim 1 defines merely the use of the device of claim 1 without additional novel features and is thus likewise obvious.

2. The subject matter of independent method claim 9 appears to be inventive:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL03/00272

D1 discloses all features of claim 9 except the following novel features:

- 1) the thin layer of the sample is "substantially single crystal"
- 2) the incident beam is "created without a monochromator", i.e polychromatic.

Although feature 1) alone is unclear and obvious for reasons put forward in paragraph 1.1. above, the subject matter of claim 9 is inventive, since both features 1 and 2 are interdependent, such that the skilled person needs two interrelated steps, which implies inventive activity.

It is however to be noted that feature 2) was not contained in any originally filed claim, but only mentioned in the description (p.5, l.31ff) and was thus eventually not searched. Thus an additional search might become necessary in the regional phase. The positive statement with respect to claim 9 (and claim 2 below) has to be seen with this proviso.

3.1. The subject matters of dependent claims 2 and 10-12 are likewise new and inventive.

3.2. The subject matters of dependent claims 3 to 7 are not inventive, since the additional features defined therein are either disclosed in or obvious from D1.

CLAIMS:

- 5 1. An X-ray apparatus for high-resolution X-ray diffraction, comprising:
- a sample stage (8) for holding a sample (16) having a front face (12) with the front face (12) oriented substantially normally to a predetermined normal direction (14);
- 10 a means (4,6) for generating a collimated beam of X-rays (11) at a predetermined target location (15) on the sample stage at an angle of between 0° and 60° to the normal direction, the beam having an angular divergence at the sample stage in the range 0.01° to 0.20° ; and
- an X-ray detector (10) arranged laterally of the sample stage for
- 15 detecting X-rays scattered by the sample (16) to a predetermined range of angles to the normal direction (14), the angles in the predetermined range being in the range from 80° to 90° .
2. An X-ray apparatus according to claim 1 wherein the X-ray
- 20 detector (10) has a linear resolution in the normal direction (14) of less than 0.002 times the distance from the X-ray detector to the predetermined target location.
3. An X-ray apparatus according to claim 1 or 2 wherein the means
- 25 for generating a collimated beam of X-rays is an X-ray source (4) and a slit (6) between the X-ray source and the sample stage
4. X-ray apparatus according to claim 3, wherein the X-ray source
- (3) has a dimension of no more than 0.2mm in the direction normal to the
- 30 beam in the plane containing the normal, the incident beam and the scattered X-rays.

REPLACED BY
ART 34

5 5. An X-ray apparatus according to any preceding claim wherein the X-ray detector (10) is an elongate X-ray detector extending in a direction parallel to the normal direction (14) for detecting in parallel X-rays diffracted by the sample as a function of distance along the normal direction and hence over a predetermined range of angles to the normal direction.

 6. An X-ray apparatus according to any preceding claim wherein the position sensitive X-ray detector (10) is a solid state detector.

10 7. Use of an X-ray apparatus according to any preceding claim to measure a sample (16) having a substantially single crystal thin layer (18) at its front face (12), the sample (16) being mounted on the sample stage (8) and oriented to diffract the collimated X-ray beam (11) onto the position sensitive X-ray detector (10).

15 8. A use according to claim 7 wherein the substantially single crystal thin layer (18) is a semiconductor layer.

20 9. An X-ray apparatus for high-resolution X-ray diffraction of a sample having a substantially single crystal thin layer, comprising:

 a sample stage (8) for holding a sample (16) having a front face (12) with the front face (12) oriented substantially normally to a predetermined normal direction (14);

 an X-ray source (4) for directing X-rays towards the sample stage;

25 a slit (6) arranged between the X-ray source (4) and the sample stage (8), the X-ray source (4) and slit (6) being dimensioned and arranged to direct a collimated beam of X-rays (11) at a predetermined target location (15) on the sample stage (8) at an angle of between 0° and 60° to the normal direction;

30 an elongate X-ray detector (10) arranged laterally of the sample stage (8) for detecting X-rays (20) diffracted by the sample as a function of distance along the length of the X-ray detector (10) and hence over a predetermined range of angles greater than 80° to the normal direction.

REPLACEMENT
ART 34 A

10. A method of high-resolution X-ray diffraction; comprising:
providing a sample stage and an X-ray detector located laterally of the
sample stage;

5 mounting a sample having a substantially single crystal thin layer
material extending in a plane on the sample stage;

directing an incident collimated beam of x-rays onto the sample at an
angle of 0° to 60° to the normal to the plane; and

10 measuring with the X-ray detector the X-rays diffracted by the sample to
a range of angles in the range 80° to 90° to the normal to the plane.

11. A method according to claim 10 wherein the incident beam has
an angular divergence in the range 0.01° to 0.20° .

15 12. A method according to claim 10 or 11 wherein the incident beam
of X-rays is in a direction from 0° to 40° to the normal to the plane.

20 13. A method according to any of claims 10 to 12 wherein the step of
measuring the X-rays diffracted by the sample (16) includes recording the
intensity of X-rays incident on the detector (10) simultaneously at a number of
locations along the length of the detector.

REPLACED BY
ART 34 A/E/07